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NORTHEASTERN FOREST EXPERIMENT STATION

Division of Watershed Management Research

Semi-annual Report

April 1963

GENERAL

We broke even the last six months: 9 manuscripts were submitted and 9 were published--but not the same ones. A two-day session at Syracuse in March gave our watershed staff two visiting professors (Sopper and Mader), and host Prof. Satterlund, a chance to discuss some new (to us) possibilities in watershed research. Satterlund and Eschner have been doing some hard thinking on snow interception and the general role of forest-snow in hydrology of the Northeast. They're presenting some of their ideas at next month's AGU meeting. Reinhart has sent some of the Fernow data to Michigan where Bob Zahner will squeeze them into his Thornthwaite program. Pierce is contracting three more weirs at Hubbard Brook and admiring his new office. Reigner is shopping for climatic instruments.

At the Syracuse meeting: we set up a 3-day visit at Coweeta in July to swap ideas with the Coweeta staff, and we placed an order for 13 volumes of Meteorological and Geoastrophysical Abstracts for Division use. Speaking of abstracts--Sid Weitzman suggested the ARS Abstracts of recently published material on soil and water conservation as a source for watershed management reference cards. We checked and found about 100 references that could be added to the cards we sent out about a year ago. We will cut the stencils and Storey's office will run them.

FERNOW EXPERIMENTAL FOREST

A paper on the results of the Fernow commercial clearcutting is in preparation which shows that, on the Fernow, skidroad conditions and other disturbance to the forest floor have more effect on overland flow and storm discharge than does the amount of timber cut or left.

Reinhart has spent considerable time on single watershed calibration and on the application of Thornthwaite procedures to our gaged watersheds. The going has been slow but we hope that the Thornthwaite approach will be useful in the single watershed calibration. A start has been made on analyzing Fernow data using a machine program developed by Dr. Zahner at the University of Michigan.

Results of Fernow research on logging-caused erosion and on water quality were re-evaluated and presented by Lull to the Federal Inter-Agency Sedimentation Conference at Jackson, Miss., in January.

Hornbeck conducted a study of comparative rates of snowmelt (or disappearance) on the Fernow clearcut and control watersheds. Snow cover frequently completely disappeared from the south slope of the clearcutting several days before disappearance on the corresponding slope of the control. As might be expected, there appeared to be little difference in rates of melt between the north slopes of the two watersheds. Snow data will be analyzed in conjunction with records of stream discharge.

Hornbeck has also been busy on an evaluation of the accuracy of our streamgaging records; this is an outgrowth of the Watershed Research Conference at Laconia last June.

We have been occupied with putting finishing touches on a number of publications. We fervently hope that in the next period we can report that the Pierce-Reinhart paper on Streamgaging stations for research on small watersheds has finally been published.

In March, Reinhart and Hornbeck participated in the Watershed Research Conference of the Northeast Station held at Syracuse. We were reassured to find that other people have their problems too.

Writing of this report has been interrupted by highwater--2-1/2 inches of rain on ground saturated from snowmelt resulting in the highest river stages since 1954.

--Ken Reinhart

#### HUBBARD BROOK EXPERIMENTAL FOREST

Considerable time has been spent these past six months on non-research activities. A sizeable chunk of Accelerated Public Works money was dumped in our laps for improving our physical plant at the Hubbard Brook Experimental Forest. Although getting out plans and contracts for public works projects restricted our research production, this money will enable us in the long run to speed up our program of gaged watersheds, and improve other facilities for future research. Further non-research effort went into assistance in administering the contract for our new Office-Field Assistants Quarters.

Over the past year or so, we have dug into the why's and wherefore's of our methods of collecting and compiling streamflow records. We examined reasons for making corrections, checking work done by others, inherent errors both from instrumentation and human actions, standards of accuracy, and other associated problems. Our findings are reported in the Proceedings of the Watershed Management Research Conference on Collection and Compilation of Streamflow Records--cited elsewhere in the Northeastern Station Report. Based on these findings we revised our procedures and came up with a manual describing in detail all the steps involved in collecting, compiling and processing streamflow data from V-Notch Weirs using Stevens A-35 water level recorders. Procedures are forthcoming for the FW-1 Recorder and the Fischer-Porter analog-to-digital recorder. Copies of this manual are available on request.

#### New Work Plans

The effects of cutting on soil moisture and temperature in a northern hardwood stand. R. S. Pierce.

The objectives of this study are to follow the march of soil moisture and soil temperature throughout the water year and then determine the effects of two cutting levels on the regimens. Measurements will be made on three one-half acre plots (with buffer strips) using a nuclear probe for soil moisture and thermocouples for soil temperature.

The effects of cutting on some climatic variables in a northern hardwood stand. R. E. Leonard.

The objectives of this study are to determine if there are significant differences in net radiation, air temperature, relative evaporation, and wind velocity among three one-half acre plots prior to treatment, and the effects of two cutting practices on the climatic factors measured. Climatic measurements will be taken at four-foot levels in the three plots and atop a 72-foot tower.

--Bob Pierce

#### NEW LISBON

As the future is generally more interesting than the past, the first part of this report will deal with plans for forthcoming studies. A meeting of the Watershed Management Division at Syracuse, recently stimulated ideas toward more fundamental research in order to apply the results of our controlled watershed studies to other watersheds in the Northeast.

In the new line-project setup, Howard Lull has designated himself as a half-time assistant to the New Lisbon project. As the Pine Barrens around New Lisbon is a "natural lysimeter" (Howard's words), this project will have a part in the new approach. Lull and Reigner recently sat down and made tentative plans for several heat balance and water balance studies. We hope at least one of them will integrate with the Forest Management project here at New Lisbon. Si Little has been considering an irrigation-fertilization study, for which water balance data will be necessary and heat balance data will be either necessary or desirable.

Returning to the past, during the semi-annual period we lined the third and last weir at the Baltimore Watershed. The wooden-box weir was designed to have a vinyl-plastic lining, but the two concrete weirs both developed leaks and had to be lined. There are other possible ways to repair leaky weirs, such as American Cyanamid's AM-9. We tried bentonite in the Newark weirs with one possible success in two trials. The vinyl plastic, however, is inexpensive and we have a good background of success with it.

Individual hook gages were installed at each weir. Previously, only one hook gage was available for all three weirs at both Baltimore and Newark. The new hook gages were inspired by Willie Curtis' Technical Note 613 but were redesigned by Bill Sopper of Penn State. They are highly accurate, constructed of aluminum, and made to size for each weir. The cost was about \$25 including fabrication which is a far cry from Curtis' estimate, but also a far cry from the cost of commercially-built gages.

In October Little and Reigner discussed the status of work and plans for the Dilldown Forest with several men from the Pennsylvania Department of Forests and Waters and from the Station's Upper Darby office. The Station's role in the immediate future is limited to providing, if possible, a feasible method of conversion to high forest through site preparation and seeding and to determining with State help what areas should be so treated.

On November 20 Harold Morey of the Washington Office and Frank Paradise of Region 7 met State Forester Cottrell, George Moorhead and Gordon Bamford at our office to discuss the use of prescribed fire on PL-566 watersheds with Reigner and Little.

In preparation for the Syracuse meeting, we reviewed many articles on water and energy balance studies including the

Thornthwaite and Mather publications. Previously, we had calculated monthly "actual" evapotranspiration, by the Thornthwaite method, for the Dilldown Watershed calibration analysis. Noting that there are three different ways to calculate "actual" ET by the Thornthwaite method, we ran a comparison of the three:

1. Using a mean temperature and average precipitation value for each month of the year taken from a group of years, compute an average monthly "actual" ET.
2. Using the individual monthly mean temperature and actual monthly precipitation values, calculate the "actual" ET for each month and average these values over the group of years.
3. Calculate daily "actual" ET, sum them on a monthly basis, and average the monthly values.

Using the ten years of data available from the Dilldown studies, the differences between the three methods were considerable and interesting. Comparing water deficits (potential ET minus "actual" ET), the average annual value for method 1 was only 0.17 inch; for method 2, it was 1.50 inches; and for method 3, 3.81 inches.

In method 1, those months having water surpluses are averaged with those months having water deficits. Actually, a surplus in July 1952 cannot balance a deficit in July 1953; there is no connection between the two events. But this is precisely what the first method does, and the results are very misleading.

Daily calculations take the timing of rainfall into consideration and present a far more accurate picture than the other two methods. For example, method 3 shows a deficit of 1.14 inches in August 1955. The early part of August was extremely dry, following a period of 6 weeks with practically no rain. But later in August came Hurricanes Connie and Diane with 19 inches of rainfall. Naturally, on a monthly basis (method 2) there would be no calculated water deficit--again an inaccurate picture.

--Irv Reigner

## SYRACUSE

### Snow Deposition and Melt

Analysis of 1961-62's snow surveys--on open land, and under brushy hardwoods, northern hardwoods, and red pine and Norway spruce plantations in the Allegheny plateau south of Syracuse--showed seasonal snow accumulations on the ground in the approximate reverse order of crown density for the sites with tree and shrub cover.

The half melt date--the date when half the seasonal accumulation of snow had disappeared--was used as an index for comparison of sites with different vegetative covers. This date was considered to be related to the prolonged high stream discharge rates during the snow melt period. It was found that half the seasonal accumulation of snow disappeared in the open and brushy hardwood sites under the cold, slow-melting conditions of late winter, before the first real spring warm spell. At the other extreme, it took approximately twenty more days of considerably higher mean temperature to dissipate half the seasonal accumulation of snow under the dense spruce stand, although this was little more than half as large an amount.

### Watershed Training Session

Northeastern Station watershed management research personnel and cooperators met at Syracuse March 5 and 6 to discuss some new slants in watershed research. Discussion centered around the Thornthwaite water balance procedure and the differential disposition of energy in forest stands.

### Streamflow Regimen and Water Yield

Preliminary analyses of the 50 year streamflow record of a 500 square mile Adirondack watershed indicates there has been a significant 4-inch decrease in the average dormant season (October-April) runoff. The growing season (May-September) decrease in flow has been less than one inch over the same period. It is felt, these changes in flow have resulted from changes in forest composition and density, following State acquisition of most of the watershed land for a park. A careful survey of available information on the history of the forest stands on the watershed area has not been very rewarding, and the history of the stands will have to be determined by detailed field study this summer.

## New Work Plan

Deposition of snow intercepted by coniferous tree crowns.  
A. R. Eschner and D. R. Satterlund.

Snow depth and water content will be measured on the branches of a number of small cut and mounted conifers, and periodically total amounts of snow intercepted will be determined by weighing the trees. Snow that slides, or melts and drips off the branches will be caught on a plastic sheet. Measurements will be taken on clear and overcast days, above and below freezing. Time-lapse photos will be taken.

--Art Eschner

## PUBLICATIONS

Influences of forest cover on snow and frost in the Adirondacks. Howard W. Lull, and Francis M. Rushmore. Eastern Snow Conference, Proceedings of the 1961 and 1962 Annual Meeting 7: 71-79.

Management for water production on municipal watersheds. Howard W. Lull. Proceedings of the Fifth World Forestry Congress 3: 1686-1690.

Comparative influence of hardwood trees, litter, and bare area on soil-moisture regimen. Howard W. Lull and Peter W. Fletcher. University of Missouri, College of Agriculture, Agricultural Experiment Station Research Bulletin 800, 15 pp., illus.

Leaf fall, humus depth, and soil frost in a northern hardwood forest. George Hart, Raymond E. Leonard, and Robert S. Pierce. Northeastern Forest Experiment Station Research Note 131, 3 pp.

Proceedings watershed management research conference on collection and compilation of streamflow records. Watershed Staff. Northeastern Forest Experiment Station, 55 pp.

Watershed management. Chapter III. Forest land management in watershed programs. Howard W. Lull. FAO Occasional Paper No. 13, 23 pp.

Forest cutting and increased water yield. Kenneth G. Reinhart, and George R. Trimble Jr. Journal of American Water Works Association 54: 1464-1472.

Suburban hydrology can improve watershed conditions.  
Paul M. Felton and Howard W. Lull. Public Works 94: 93-94.

Soil-moisture depletion by a hardwood forest during drought years. Peter W. Fletcher and Howard W. Lull. Soil Science Society of America Proceedings 27: 94-98.

Manuscripts Submitted

Some observations on precipitation measurement on forested experimental watersheds. Raymond E. Leonard and Kenneth G. Reinhart.

Efficient logging protects water quality. Kenneth G. Reinhart.

Effect of a commercial clear cutting in West Virginia on overland flow and storm runoff. Kenneth G. Reinhart.

Approximating soil-moisture storage in experimental watersheds using precipitation and streamflow records. Kenneth G. Reinhart.

Cutting the forest to increase water yield. George R. Trimble Jr., Kenneth G. Reinhart, and Henry H. Webster.

Logging and erosion on rough terrain in the East. Howard W. Lull and Kenneth G. Reinhart.

Controlling erosion from mountain logging. James W. Hornbeck and Kenneth G. Reinhart.

Variations in bulk density and moisture content within and between closely-spaced plots on Lakeland and Lakehurst sands. Irvin C. Reigner and John J. Phillips.

Snow deposition and melt under different vegetative covers in central New York. Arthur R. Eschner and Donald R. Satterlund.